**Half-Lives of Radioactive Isotopes**

Transmutation

* In (natural) transmutation, the nucleus spontaneously decays into a new element.

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* In artificial transmutation, the nucleus is first bombarded with high energy particles, then decays and changes into a new element.

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Half-Life

* Every radioisotope has a rate of decay.
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* **\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lists half-life, decay mode (particles emitted during decay), nuclide (radioisotope, and name of nuclide.
* The half-life of Ra-226 is 1600 years; meaning, in 1600 years half of Ra-226 will decay, and in another 1600 years half of what was remaining will decay.
* After 3200 years, how many half-lives has Ra-226 gone through?

Common Radioisotopes

* Carbon-14 (C-14) has a half-life of 5700 years and is used to date once living (organic) material
* Uranium-238 (U-238) has a half-life 4.5 billion years and is used to determine the age of rock
* Iodine-131 (I-131) has a half-life 8.021 days and is used for treatment of thyroid disorders
* Cobalt-60 (Co-60) has a half-life 5.271years and is used for cancer treatments

Fraction Remaining

* $$ has a half-life of 8.07 days. A 10 gram sample was allowed to decay for 32 days. What fraction will remain?

What is the Half-Life?

* 100 grams of a radioisotope decayed to 12 ½ grams after 90.7 years. What was the half-life?

What was the Initial Amount (Original Amount)

* A radioisotope has a half-life of 10 days. 1 gram remains after 40 days. What was the initial amount of the radioisotope?

More - Mixed Half-Life Practice

1. How long will it take for 30 g of 222Rn to decay to 7.5 g?
2. How many grams of 16N will be left from a 16 g sample after 21.6 s?
3. How many half-lives will it take for 50 g of 99Tc to decay to 6.25 g?
4. What fraction of a sample of 32P will be left after 42.9 d?

Regents Questions

1. Which radioisotopes have the same decay mode and have half-lives greater than 1 hour?
	1. Au-198 and N-16
	2. I-131 and P-32
	3. Ca-37 and Fe-53
	4. Tc-99 and U-233
2. After decaying for 48 hours, 1/16 of the original mass of a radioisotope sample remains unchanged. What is the half-life of this radioisotope?
	1. 3.0 h
	2. 9.6 h
	3. 12 h
	4. 24 h



**Half Life of a Twizzler (or any other object)**

Directions:

1. On the graph provided below, label the y-axis “Amount” and the x-axis as “Half-Life,” and title your graph
2. Number the x-axis from 0 to 10
3. Get 2 twizzlers (or objects that can be cut in half easily
4. Place the first whole twizzler at 0 half-lives and mark the top of the piece on the graph
5. Cut the 2nd twizzler in half and place one half at Half Life 1 and discard the other half (eat or garbage) and mark off point on graph
6. The twizzlers on the graph represent the amount of original material left, and the discard twizzlers represent the decayed material
7. Repeat until you can no longer easily divide the twizzlers in half
8. Draw a smooth line connecting all your marks

The Graph



Analysis:

1. What is the shape of the line on your graph?
2. How would you describe what happens to the amount of twizzlers after each step?
3. Suppose the units on the x-axis are seconds. What is the half-life of your twizzler?
4. Using your graph, determine whether this statement is true or false. Explain your answer. ***Half-life means that half of a sample decays after one half-life and the rest of the sample decays after the next half-life.***
5. One reason it is important to know the half-life of a sample is to safely dispose of radioactive waste, which is usually stored for 10 half-lives. If you have 250 g of radioactive waste, how much of the sample would be left after 10 half-lives?
6. Radioisotope A has a half-life of 2 minutes. Radioisotope B has a half-life of 2 hours. Which one would have a larger amount left after 5 hours has elapsed?
7. Iodine-131 has a half-life of about 8 days. If you had 60 grams of I-131, how much would remain after 24 days? Show your work.